

Eiginio Rodriguez

450 N. San Gabriel, San Antonio, Texas 78228-6116, Telephone (210) 434-1026 E-mail:

April 8, 2003

Subject: EPA Public Listening Session SATX

To Whom It May Concern:

My name is Eiginio Rodriguez I am a life long resident of the City of San Antonio, Texas. My concerns on water protection and the never- ending encouragement and support of others brought me here before you today. I have enclosed a copy of a letter I have sent to local, state and Congressional Officials regarding my concerns. I have also enclosed a copy of my report plus copies of responses. The Edwards Aquifer Authority Mr. Geary M. Schindel Chief Technical Officer requested a copy of my report as to properly reply to State of Texas Senator Jeff Wentworth. Mr. Jerry "Martin" Green former Edwards Aquifer Authority Board member initiated Mr. Schindel's request for my report. Mr. George Rice Hydro-geologist and current board member of the Edwards Aquifer Authority and Mr. Jerry "Martin" Green (while still an active EAA board member) as did many others saw my work in progress and too were hounded with my never-ending questions. One of the most basic necessities for life regardless of age is water. Therefore, I leave with you my findings, responses I have received and other information that may help not only our aging population but also the many future generations to come. Thank you for your time.

Sincerely,



Eiginio Rodriguez

450 N. San Gabriel, San Antonio, Texas 78228-6116, Telephone (210) 434-1026 E-mail:

COPY OF LETTER SENT TO GOVERNING OFFICIALS

January 6, 2003

Dear Sir:

I am writing to inform you of a potentially dangerous situation regarding the protection of the Edwards Aquifer Recharge Zone, as well as the protection of other such areas. In summary, I found that there are no state or federal written rules, regulations or standard operating procedures for Firefighters to follow as to protect an aquifer recharge zone. There are clean up procedures after the fact but no specific procedures in relation to an aquifer before or during an incident. There is a lack of a set "standard of care," for aquifer recharge zones vs. creeks and other visible waterways. Although the Edwards Aquifer Recharge Zone provides for the drinking water of over a million citizens, it has somehow escaped being considered a vulnerable exposure to protect during an incident. Due to numerous jurisdictions and agencies encompassing this issue, I respectfully request your review and possible intervention and advice. I sincerely feel your prudent and just judgment is a must for this most important issue. Enclosed are my findings.

Respectfully yours,



Eiginio Rodriguez
Concerned Citizen

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<http://news.mysanantonio.com/global-includes/printStory.cfm?xla='saen'&xlb=980&xlc=912193>

Carlos Guerra: Retired firefighter points out perils of recharge-zone fires

San Antonio Express-News

Web Posted : 01/05/2003 12:00 AM

For years, 38-year-old Eiginio Rodríguez dreamed of a career as a firefighter. And after some other jobs, the Holy Cross grad did land a job with the San Antonio Fire Department. But in 1993, a work-related injury ended his dream.

Since then, he has involved himself in various civic endeavors, but never lost interest in firefighting.

Last fall, while in the far northern reaches of Bexar County, he says he was amazed at how intensely the Edwards Aquifer recharge zone has been developed.

"I walked into one store and saw all these cans of (motor) oil, antifreeze and chemicals, and it dawned on me," he recalls.

Fighting fires isn't just about putting out the flames these days, he says. Today's smoke-eaters must also watch for the toxins released or created by a conflagration, and plan for disposal of possibly toxic water left after the fire is out.

And the Edwards, unlike other aquifers, doesn't filter much from the water that recharges it. Water — with whatever is in it — simply flows into the porous limestone and is later pumped out, chlorinated and piped to homes.

"I remembered being at a big warehouse fire where the water was up to our knees," Rodríguez says. "And I thought: If that happened over the recharge, where would all that water go?"

He started investigating how fires should be battled in sensitive aquifer recharge areas.

"I thought that there must be rules and procedures to protect this area (from fire-related hazardous materials)," he said. "But I was surprised to find nothing."

He did uncover procedures to protect "visible exposures" like lakes and rivers to prevent incidents like the 1986 fire in Switzerland that resulted in contamination of five miles of the Rhine.

But Rodríguez found only one mention of guarding an aquifer in a firefight.

In 1987, a warehouse full of paint over an aquifer recharge area in Dayton, Ohio, was fully involved when firefighters arrived. Because of the aquifer, the officer in charge ordered that it be allowed to burn itself out to minimize the dangers of contamination.

That decision set off a brouhaha because it cost the building's insurance company \$38 million.

So, Rodríguez wrote the Texas Department of Insurance for guidance in finding how such fires should be handled in Texas. He was referred to the Texas Fire Marshal, who sent him to the marshal's legal staff.

He also contacted the Occupational Safety and Health Administration and the U.S. Environmental Protection Agency. At EPA, he was directed him to the Texas Commission on Environmental Quality.

Finally, he concluded that there are no procedures for safely battling blazes over recharge areas.

"Some (agency staffers) told me these fires should be treated like a chemical spill," he says.

"But building sandbag walls around a fire on the recharge zone is like building a swimming pool without a bottom.

"All of these agencies are only prepared to deal with (fire-borne contamination) after the fact," he says, "when it may be too late and very expensive to clean up."

Rodríguez's point merits legislative attention. The Edwards provides water to almost 2 million, and considering how rapidly its recharge area is being allowed to develop, protecting it during fires demands action now.

"Shouldn't the Edwards be given at least the importance of 'visible exposures?'" Rodríguez asks.

It's a fair question.

To leave a message for Carlos Guerra, call (210) 250-3545 or e-mail cguerra@express-news.net. His columns appear Sundays, Tuesdays and Thursdays.

01/05/2003

**Fire
And
Hazardous Material
Containment
Over The
Edwards Aquifer:

A Liability Nightmare
Waiting to Happen**

**By
Eiginio Rodriguez**

November 19, 2002

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Acknowledgements

I am deeply indebted to God, my family and all whom unselfishly shared their knowledge, skills and support during the creation of this paper.

Thanks to the staff of the City of San Antonio Public Library and the St. Mary's University Library.

Thanks to all citizens and members of diverse groups, organizations and agencies that graciously listened and encouraged I continue this research.

Special thanks "gracias" to Antonio Cabral for sitting with me and accepting the challenge of editing this work. Known before as, " Overview of Fire Protection Rules, Regulations, Training and Standard Operating Procedures for Fire Suppression, Hazardous Material Containment and Potential Insurance Liabilities Over the Edwards Aquifer Recharge Zone."

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About the Author

Mr. Eiginio Rodriguez is a retired professional firefighter of San Antonio, Texas. He satisfactorily completed in 1988 the requirement for becoming a City of San Antonio firefighter including agility entry exams, extensive background checks, medical and psychological testing, lie detector testing and numerous interviews. He completed the prescribed formal classes at the San Antonio Fire Academy and the University of Texas Health Science Center (School of Medicine) for State Certification as a Firefighter and Emergency Medical Technician (EMT). He completed the required classroom training in Radiological Monitoring conducted by the Texas Department of Health. He also earned an Associate Degree of Applied Science (Fire Science) with Presidential Honors from San Antonio College in 1993.

Epilogue

In an effort to become an informed citizen during the development negotiations between the City of San Antonio and the Lumbermen's Investment Corporation to develop a PGA Village over the Edwards Aquifer recharge zone, I researched the protection requirements against fires and chemical spills over that sensitive zone.

I was surprised to discover the absence of rules, regulations, SOP's and training for fire protection over the recharge zones. I also discovered that a multitude of entities including the Texas Department of Insurance, the Environmental Protection Agency (EPA) and several other regulatory state and federal agencies do not know or simply choose to ignore the vulnerability of the aquifer recharge zones.

I became concerned over the lack of fire protection, rules, regulations and standard operating procedures for fire suppression, hazardous material containment and the potential insurance liabilities on all structural development over the Edwards Aquifer.

The following document hopefully will help to inform in a positive way everyone who is concerned over the protection of that vital source of drinking water and to homeowners and businesses that have invested in purchasing structures over the Aquifer. It is intended to raise public awareness of the delicate balance between an aquifer recharge zone and an emergency situation as well its potential financial cost to the nation, state, county and to the city as well as to home and business owners and insurance companies.

Edwards Aquifer and Recharge Zone

The Edwards Aquifer is located in South central Texas.¹ It is recognized by the USGS (United States Geological Survey) as an underground karstic (limestone) porous rock formation aquifer.² The Edwards Aquifer is the first aquifer to be designated a Sole Source Aquifer by the EPA (Environmental Protection Agency 1975)³ and serves the water needs of over 1.7 million people⁴ over an area of eight counties.⁵ Under certain EPA contamination scenarios, sites can be overtaken⁶ by eminent domain.⁷ Actions are taken to protect the sources of water that provide water to over fifty percent of a given population.⁸ Such option has already been applied in cases like a contaminated site in Arkansas.⁹

The Edwards Aquifer recharge zone acts as a conduit to collect water for the Edwards Aquifer. The rock formations at these areas do not filter but only act as conduits.¹⁰ According to my interview of officials of the TNRCC (Texas Natural Conservation Commission now TCEQ (Texas Commission Environmental Quality)), the Edwards Recharge Area varies in thickness. Some recharge areas have about two feet of soil and between one hundred to four hundred feet of limestone. Other areas have between four hundred to one thousand feet of limestone before reaching the water.¹¹ Apart from porous rock and fissures, there are openings created by naturally occurring aerations from plant and tree root processes.¹² The USGS 1978-1989 official survey says that the "known or inferred thickness, is between 350 to 850"¹³ feet with 15-35 percent porosity.¹⁴ Due to the natural characteristics of a karst aquifer's landscape, some visible and some hidden "land-use hazards"¹⁵ are present. Such hazards include irregular ground and underground topography that creates the potential of ground sinking due to deeper foundation irregularities and cavities not accustomed to the weight of manmade development.¹⁶

Regarding contaminations, agencies such as the Edwards Aquifer Authority and the TNRCC (TCEQ) again and again say that sources of contamination are difficult to find.¹⁷ This is true because of the way the rock formations are formed. It is similar and can best be described as a popular TV show game in, "The Price is Right," called PLINKO.¹⁸ Point source¹⁹ contaminations are cleaned up with Superfund monies, state monies, owner funds or insurance coverage consecutively. Unfortunately even supposedly obvious cases cannot be reported and attributed to firefighting actions. It cannot be ascertained if the contamination occurred before, after, or during firefighting actions. Note: according to a witness of an Uvalde fire incident, a drinking water well located at a distance from the fire was still close enough to have the fire suppression water runoff gush into it. During my attempt to find information of such incident, I was told by TNRCC (TCEQ)," that the witness to the incident may have a very just cause to believe the closing of the water well was due to fire suppression water run-off. However, due to sources of contamination being difficult to find, a report that correlates the firefighting runoff to the closing of the well in question is nonexistent."²⁰ The source is forgotten and just like the PLINKO game chip, contaminants can get stuck along the way.²¹ In another case regarding a similar aquifer, "the source of contamination was found twenty-five kilometers away."²² Normally karst aquifer terrains allow rainwater to carry pollutants without filtration.²³ I wonder where firefighting suppression runoffs of large amounts of water go, especially when the incident involved is over an aquifer recharge zone.²⁴

United States National Fire Academy report summary of May 27, 1987 fire incident.²⁵

Due to agencies repeatedly stating that the sources of aquifer contaminations are difficult to find, it was by chance I found what seems to be the only fire incident report that mentions a fire scene and an aquifer.

A US National Fire Academy report, states that on May 27, 1987, in Dayton, Ohio, an incident regarding the fire of a Sherwin-Williams Paint Warehouse occurred over an aquifer. When firefighters arrived at the scene, the warehouse was already fully involved in flames. Through preplanning, the firefighters were aware of the aquifer as a hidden *exposure to protect. They knew of the possible damage that could be caused from water run-off used to extinguish the fire. The fire incident's officer in charge made the decision to let the warehouse burn itself out on its own. Many liability questions arose from this incident. Should the Fire department be responsible for notifying insurance companies that due to the hidden exposure fire suppression may not be conducted? Could the building have been saved had the fire department attempted to fight the fire? Would the department's municipality have been liable for damages that would have occurred to the aquifer had they delivered water to extinguish the fire? The insurance company decided not to sue the Fire Department for not extinguishing the fire and tentatively paid Sherwin-Williams. One employee was injured and the fire ultimately resulted in a \$32 million dollar loss. Luckily no damage to the aquifer occurred and continued to provide water for its 400,000 users.

A report supplement states that the possible reason this fire department was so prudent in their actions was because of a Basel, Switzerland fire incident a year before involving contamination of the Rhine River. The Rhine is a visible river versus a hidden underground water source as is the case with an aquifer. The structure fire in that case was fought as any other fire scene, by pouring water on it. Later it was found that the Rhine was contaminated for a distance of five miles. Recent chemical comprehensive testing found mercury contaminants still linger on the Rhine. Indeed the Ohio firefighters having placed the underground aquifer as an exposure to protect was a prudent decision.²⁶

**(According to professional firefighting terminology, an exposure is an adjacent or adjoining area, property, site or occupancy, vulnerable to fire, chemical or other form of damage from a past, future or ongoing incident. In this paper I use the term "hidden exposure" to mean an exposure not easily visible).*

Findings regarding set Federal or State standard rules and regulations.

Fire protection codes, rules and regulations for firefighting procedures over aquifers, specifically recharge zones, are non-existent.²⁷⁻¹ Standard procedures used on other areas may be detrimental for areas such as a recharge zone. Case studies are non-existent because of the fact that aquifer contamination sources are difficult to find. The NFPA (National Fire Protection Association) Handbook, regarding most or all conceivable fire fighting scenarios, has no information regarding fighting fires or containment of hazardous materials over an aquifer recharge zone.²⁸ OSHA (Occupational Safety and Health Association), is an organization responsible for a multitude of rules and regulations of work places including containment of firefighting water runoff from chemical plant fires near bayous.²⁹ It has no information regarding aquifer recharge zones. In all cases, if the body of water can be seen, precautions are taken. If it cannot be seen, such as in the case of an aquifer, TNRCC (TCEQ) remediation takes

over after the damage has been done. Remediation are costly cleanup procedures requiring specially trained personnel to chemically neutralize (when possible), bag, shovel, suction or bulldoze and remove contaminated dirt in order to capture as much of the contaminant as possible. Complete cleanup is not always possible so the capping of affected wells does occur.³⁰

In complete combustion³¹, most vehicular, building construction, and household products that are burned breakdown into compounds containing carbon and hydrogen atoms and molecules. Carbon and hydrogen are found naturally in nature as hydrocarbons and are decomposed by certain bacteria. Unfortunately, in real life, incomplete combustion is what does occur.³² Combustible materials from organic to inorganic materials as metals, plastics, fabrics, vinyl, paints and rubber materials melt or crackle, producing smoke. Also, such items pulverize or go through a change of liquification during the burning process.³³ Smoke, being the suspension of particles in air, create soot particles that fall upon surrounding areas.³⁴ How much of these broken down particles are swept away onto an aquifer from firefighting water or fire suppression chemical runoff (i.e. using chemicals to extinguish fires), is unknown. The Forest Service, the most publicly known user of chemical suppression, has yet to make an aggressive effort to study water source contamination or non-contamination from such fire suppression activities.³⁵ Smoke does contain a common toxin, carbon monoxide, but there are also other particles that contain traces of other toxins. PVC³⁷, foam, plastics and many other everyday items do produce traces of more ominous gasses from chlorides to cyanides. Treated woods³⁶ do have a warning label warning that such wood should not be burned due to toxins it can produce. Such is the case because many products require the use of Toxic Materials: Class B poisons to get the desired results.³⁸

"Hazardous materials cleanups over recharge zones, such as from vehicular spills, are the same as for a spill at any other area. What some do not understand is that building dams for containment over such areas can be like building a swimming pool without a bottom. New technological advancements of chemicals that can be poured on small spills to make hydrocarbons (oils and fuels) water-soluble are useful. How safe are such chemicals for human consumption? No one knows. Highways over such areas have, through EPA intervention, hazardous spill containment ditches to contain any accidental fuel or other spills from vehicular accidents. Sadly, such safety measures are as good as the weather permits. Fuels, being lighter than water, can be swept away by rains as the process of cleanup is progressing."³⁹

Average aquifer clean up cost when possible

"One quart of oil can contaminate up to 2 million gallons of drinking water; 4 quarts of oil can form an oil slick approximately 8 acres in size" (University of Maryland Cooperative Extension Service, 1987).⁴⁰ A gallon of gasoline can contaminate five million gallons of water.⁴¹ Average vehicles carry 10 gallons of gasoline. Diesel tractor trucks at minimum have one eighty-gallon diesel fuel tank while other trucks carry two one hundred twenty gallon diesel fuel tanks on each side.⁴² Other contaminants we take for granted are oils, antifreeze, batteries, gasoline, paint, insulating wiring, upholstery, tiles, counter tops, plastic components etc.⁴³ All of these are found within any home or commercial building. Due to concerns about hazardous cargo, the Bexar County Local Emergency Planning Committee was formed and became responsible for

the rerouting of hazardous material cargo.⁴⁴ It helped move hazardous material transports from populated inner city areas, but as for protecting the aquifer recharge zone it did nothing.

The EPA reports that the average cleanup cost of a contaminated aquifer site is three million dollars. It is also reported that cleanups are sometimes impossible to perform and can only be resolved by the capping of any wells involved.⁴⁵ In cases of Texas aquifers, the TNRCC (TCEQ) performs the cleanup or remediation.⁴⁶ Regarding fire scenes, only large structure fire scenes are remediated. Smaller fire scenes such as apartments or homes, are not remediated. It is assumed that such firefighting runoff contaminants are safe or negligible. How many negligible incidents it will take to make them just as important as any other fire scene remains to be seen.

Insurance Liability

More and more development is being encouraged over recharge zone areas.⁴⁷ Businesses or owners involved in accidental chemical spills or other contamination do pay fines and also pay for their own cleanups.⁴⁸ As for Firefighting liability, I have found that the State of Texas has not addressed the insurance questions raised by the Dayton, Ohio, incident. The Texas Insurance Commissioner and Fire Marshal have never been confronted with these very important questions. The Texas Commission for Fire Protection, responsible for certifying Texas Firefighters, also has never addressed the question of firefighting actions over aquifer recharge zones. Rules, regulations and specialized training should be required for such areas. The ongoing question when involving such areas should be whether to save a structure or to protect the drinking water of millions of citizens.

Recommendations

I took it upon myself to keep some information, although public but potentially dangerous, out of this paper. I do not know who will read this; therefore it is my duty as a concerned citizen, especially after September 11, not to facilitate any type of threat to our National Security.⁴⁹

- 1) Governmental agencies must begin to act before the fact and not after. So far, luck seems to be on our side because clean ups in some cases have worked. Government personnel charged with such responsibilities should understand the importance of the protection of water for the proper functioning of a city, state or country. At one time, ignorance was an excuse. That excuse no longer exists and future development for economic reasons is no longer valid. The potential for negligence must be avoided.⁵⁰
 - a) Environmental Protection Agency (EPA), Texas Natural Conservation Commission (TNRCC now TCEQ), and OSHA (Occupational Safety and Health Administration) develop plans of business protection after a problem arises then use such protections on newer similar developments. The Federal Remediation Technologies Roundtable⁵¹ should, when it comes to unseen water sources, be compelled to protect such areas before the fact.
 - b) Existing aquifer authorities should be informed and encouraged to participate. The Edwards Aquifer Authority has made some progress in requiring underground gasoline storage tanks to be removed. They are now to be placed in special above ground containments. Unfortunately, the influence of large

corporations has slowed the progress that all underground fuel tanks over the recharge zone be removed. Protecting an aquifer from fire aftermaths will be a challenge requiring prevention instead of intervention. At this time the incidents that can be used as models are those that have affected a river, creek or other visible waterway.⁵²

- c) The NFPA should be requested to research and write codes for fighting fires and for hazardous spills containment procedures over aquifer recharge zones.
 - d) The National Fire Codes Subscription Service should be informed of the lack of such procedures.
 - e) The Federal Emergency Management Agency (FEMA) should be requested to investigate.
 - f) All entities responsible for such protections should be consulted if possible. One must be wary that politics and economic growth factors not jeopardize this hidden National Security priority.
 - g) Zoning codes for certain non-recharge zone areas are negotiable, but zoning code amendments for recharge areas should not be taken lightly. The economic benefits may not be enough to remedy the hidden potential for disaster. Some chemicals show harmful effects only after long accumulative exposures of acceptable levels. It is unfortunate that we learn as we go.
 - h) The Texas Department of Insurance Commissioner, insurers and subsidiaries should be made aware of the potential for liabilities. Incidents of hurricanes have caused insurance companies to curtail their protection for businesses and homes in such areas. Aquifer contaminations are as darts on a dartboard little by little they do add up. A catastrophic aquifer contamination will affect all parties involved and will affect commercial and private water users of the aquifer. The negative economic impact could be substantial, costly and could require a new water source for users.
 - i) The cost of local, TNRCC (TCEQ) or EPA intervention over aquifer recharge zones should be placed upon owner insurance first then state or federal intervention consecutively.
- 2) Due to the non-existence of NFPA rules, guidelines for Fire Protection of existing structures should be written as SOP's (Standard Operating Procedures).
- a) The first and most important aspect from a firefighting hazardous material point of view will be teaching personnel what environment they are to protect, how it acts and reacts to certain conditions. Standard Operating Procedures for Firefighters should include written orders on how to best handle an incident without damaging the underlying recharge zone. Such SOP's may make repeated remediation (cleanups) the exception not the norm.
 - b) Preplanning activities from inspectors and firefighting personnel should include the recharge zone as a critical zone that must be considered. The preplanning for such areas may require, in certain cases, the reviewing of any past incidents over the same area that could have created additional pitting or formations of porous conduits from carbonic or other acid activities. The preplanning for areas will require the knowledge of where trees once existed if possible (root

systems can act as conduits underground sometimes immediately or by rotting with time). Preplanning over such areas must not be as in the past, but must also have to deal with protecting the water of millions of citizens.

- c) The NFPA 704 Standard System of Identification⁵³ could be utilized to identify structures that contain hazardous materials. The system uses a diamond symbol consisting of four equal sized areas. Each is color coded and numbered as to indicate the severity of the contents involved and any special circumstances that must be considered. Businesses and private homes must be required to participate in identifying potentially hazardous materials⁵⁴ firefighters will encounter in an emergency. If the use of the diamond symbol is too complex, all structures located over recharge zones should be clearly identified by some placard or identifying symbol to warn all civilians and fire personnel of the underground exposure.
 - d) Fire scenes and or chemical spill containments over such areas with written SOP's and obvious identifiers will help firefighting company officers make very difficult decisions somewhat easier.
- 3) Realtors and homeowners selling property over recharge zones should be required to inform potential customers of the underlying aquifer. It must be made clear that their everyday activities must always keep the protection of the underlying aquifer in mind.
 - 4) NFIRS (National Fire Incident Reporting System)⁵⁵ should request that incidents occurring over aquifer recharge zones mention the recharge zone as an exposure. The incident regardless of size may or not affect the aquifer but it should still be noted. The information gathered can become a great resource for all involved as to what measures work. Acknowledgement of an underlying exposure will allow for future cross-referencing of remediation and fire or hazardous containment incidents for study.
 - 5) Since such areas are already recognized by TX-DOT with highway signs saying Entering Recharge Zone, it is difficult to claim ignorance of such a sensitive environment. To reduce the cost to taxpayers from such cleanups, business and home insurance protection should be made responsible. The signs are plain and clear on large highways.

Conclusion

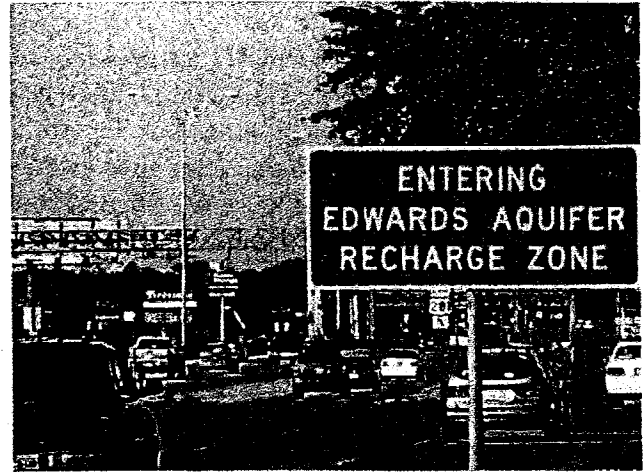
Large business parking lots have containment drainages for parking lot runoff containment. These containment ponds can hold on average 20,000 to 50,000 gallons of water. The problem is that firefighting equipment at large structural fires can produce from 200 gallons per minute of water per handheld hose nozzle, to 1000 gpm per monitor (cannon type equipment), snorkel truck and aerial ladder pipe truck nozzle.⁵⁶ During such an incident, in order to take advantage of the containment ponds, firefighters would have about forty-five minutes to completely contain

such a fire. The truth is that such fire scenes from businesses or even large homes or apartment complexes normally take hours.

Federal and State rules, regulations, and specialized firefighting training including the implementation of the NFPA 704 Diamond or similar should be addressed and required for such areas. Professional or volunteer fire departments of municipalities should have written Standard Operating Procedures in place for fires (vehicle, house, apartment, business, radiology labs etc.), biological spills, and other spills to alleviate the on-scene decision making required over such sensitive aquifer areas. Radiological is mentioned because X-Ray using businesses can already be seen over aquifer areas. The economic growth of a city is important, but when an economic growth catalyst jeopardizes the water of millions, our government must step in and do what is prudent. Government decisions are not easy and this issue is complex and overlaps several governing agencies. Due to the monies involved and economic benefits of some development projects, governing officials are pressured to change zoning laws to accommodate such development. Ironically, a former mayor of our city once called for a development moratorium over the aquifer recharge zone, yet he recently encouraged development over the same area. Since that former mayor is now a developer, his changing opinion may be motivated by his personal economic pursuits.

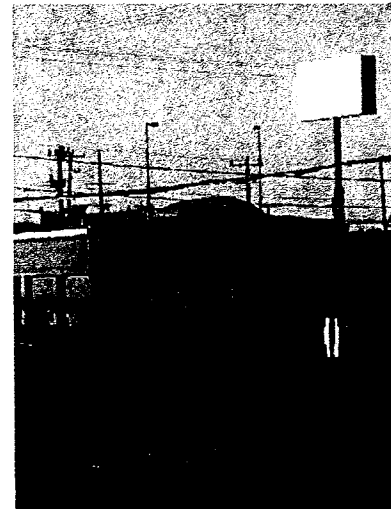
The issue that made me look into this problem made me realize that developers approach state and local representatives to change zoning and tax districting situations. The agencies that are there to protect such areas, such as the Edwards Aquifer Authority and the TNRCC (TCEQ), are in a sense undermined by others. The protection of an aquifer recharge zone should never have become so politically vulnerable, especially when the protection of the water of millions of citizens becomes a footnote when confronted with big money projects. Paleolithic sites have also become victims of development.⁵⁷ Economic catalysts are the dream of every city, but common sense must prevail and difficult decisions must be made based on the fact that water is life.

Descriptions and review through photos (11-9-02).



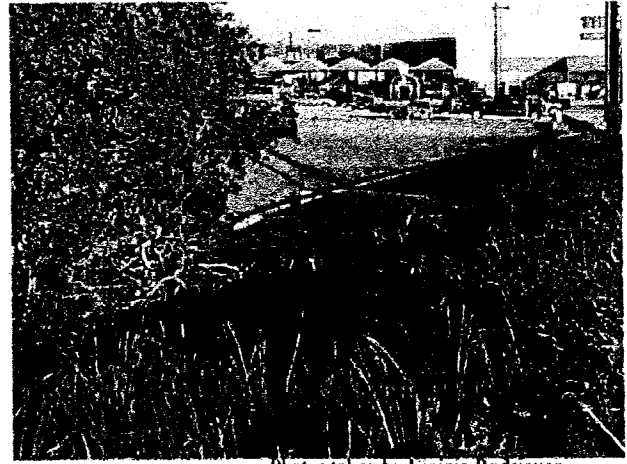
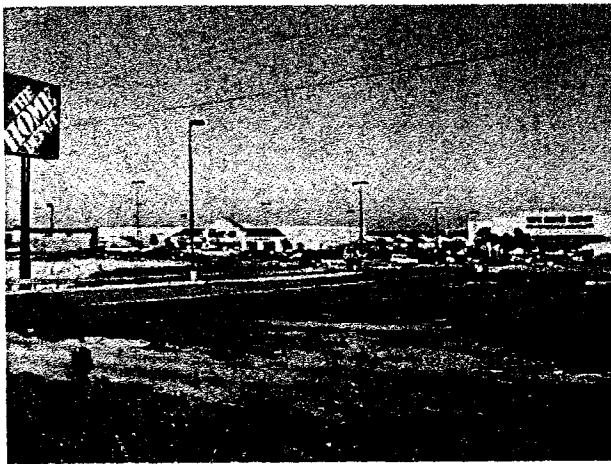
Photos taken by Eginio Rodriguez

The above picture was taken on Hwy 281 north. Growth is already expansive over the recharge zone area. Radiation is a concern because an animal hospital is located near this area. No studies are available for such contaminations, because the Aquifer Recharge zones are not noted on NFIRS (National Fire Incident Reporting System).



Photos taken by Eginio Rodriguez

Intersection of Hwy 281 and Loop1604 overpass (also known as Anderson Loop). Large businesses already exist, i.e. Wal-Mart, HEB, countless fast food, gasoline stations and others.
Right: Over the aquifer recharge zone is a Sherwin-Williams store.



Photos taken by Eiginio Rodriguez

Hwy 281 and Evans Road. Besides this HEB, there are many other businesses. Including a dentist office that raises radiation concerns. This site is said to have had a natural spring before development occurred. Right: A view of the containment pond. The large drainage openings from the parking lot area can be seen.



Photos taken by Eiginio Rodriguez

Photos taken from the road adjacent to a parking lot containment pond. At first sight the view looks appealing but then looking at it carefully one realizes that the tree roots create fissures on the topography (right). The pond is much lower than surrounding area, meaning it is that much closer to recharge formations. The removal of such foliage would only hide the problem of root formations (see following photos). According to TNRCC, drainage valves are supposed to be closed to protect ponds from fire suppression runoff. Obviously, such runoff would go underground into the aquifer.



Photo taken by Eginio Rodriguez

A stonewall fence surrounding a subdivision is behind about six feet from this edge. One can appreciate that the cutting of foliage did clear the area above for aesthetics. The exposed roots below, which were left behind, should rot with time. This type of terrain requires that that such foliage must be taken into consideration during preplanning by fire departments. Preplanning before, during, and after construction must be done.



Photo taken by Eiginio Rodriguez

Another view of outcrop formation resulting from construction of a nearby road. Notice the natural conduits created by the stones themselves.



Photo taken by Eiginio Rodriguez

Notice rock formations at the top layer are similar those in prior photos. Such formations show large rock fissures on the bottom layers. Such formations and fissures act as conduits for the flow of rainwater into the Edwards Aquifer. This large out crop is also result of road construction along Hwy 281 north and Evans Road. It is located across the road to a strip mall that has a Home Depot, HEB stores and a previously mentioned runoff containment pond.



Photos taken by Eginio Rodriguez

Photos of already existing development must be taken into consideration during preplanning by fire personnel. The terrain is deceiving to make competent firefighters believe that routine firefighting procedures or spill containment can be exercised. The truth is that over such sensitive aquifer areas, fire suppression personnel should have written orders and training that best protects the underlying recharge zone.⁵⁸ Having to call TNRCC (TCEQ) and EPA time and time again for remediation, only means there is a very serious weakness when handling such situations.

The trees seen on the left lead to a very deep drop onto a creek bed with similar rock formations as those shown before. In the distance one can see homes under construction. The construction codes used are the same as for those anywhere else. Building codes do take foundation problems into consideration to protect the building from shifting, but none are in place to protect the aquifer recharge zone. The potentially dangerous building materials used everywhere, are used over these sensitive areas.

NOTES

¹Compiled by: Roberto Esquilin, Hydrogeologist EDWARDS AQUIFER BIBLIOGRAPHY THROUGH 2001 http://www.edwardsaquifer.org/Pages/frames_aquifer.html eaabib2001.pdf p.2 par 1

²United States Geological Survey (USGS)
http://water.usgs.gov/ogw/karst/kigconference/elk_traveltimes.htm Travel Times Along Selected Paths of the Edwards Aquifer, Central Texas, Introduction p.1 par1

³National Water Quality Inventory, 1998 report to Congress (305(b) report)
http://www.epa.gov/ogwdw000/protect/98_305b_all.pdf Sole Source Aquifer Protection Program, p.57 Sole Source Aquifer EPA designation 1975 after Clean Water Act of 1974.

⁴Compiled by: Roberto Esquilin, Hydrogeologist EDWARDS AQUIFER BIBLIOGRAPHY THROUGH 2001 http://www.edwardsaquifer.org/Pages/frames_aquifer.html eaabib2001.pdf, p.1, "approximately 1.7 million people served in San Antonio area."

Edwards Aquifer Authority, Aquifer Data, Hydrogeologic Data Report
http://www.edwardsaquifer.org/Pages/frames_aquifer.html

⁵<http://www.edwardsaquifer.net/> excellent map of the Edwards Aquifer Region showing counties.

⁶<http://www.gao.gov/RCED-99-245/AR/ARD008052508.html> Information from GAO Superfund Survey 1999 [Arkansas] POPILE, INC (ARD008052508), Access to site (property involved) restricted.

⁷RONALD REAGAN, THE WHITE HOUSE, March 15, 1988, Government Actions and Interference with Constitutionally Protected Property Rights EXECUTIVE ORDER NO. 12630 March 15, 1988, 3 C.F.R. 554 <http://www.epa.gov/OWOW/wetlands/regs/eo12630.html> Eminent Domain, (d4), 1-4

Fact Sheet: The Effect Of Superfund On Involuntary Acquisitions Of Contaminated Property By Government Entities.
<http://www.epa.gov/Compliance/resources/policies/cleanup/superfund/fs-involacqurpty-rpt.pdf>

⁸National Water Quality Inventory, 1998 report to Congress (305(b) report)
http://www.epa.gov/ogwdw000/protect/98_305b_all.pdf Sole Source Aquifer Protection Program, p.57, criteria for Sole Source Aquifer designation more than fifty percent of area population must rely on its use as primary water source.

⁹<http://www.gao.gov/RCED-99-245/AR/ARD008052508.html> Information from GAO Superfund Survey 1999 [Arkansas] POPILE, INC (ARD008052508), Access to site (property involved) restricted.

¹⁰KARST HYDROLOGY Concepts from Mammoth Cave Area Edited by William B. White and Elizabeth L. White (Van Nostrand Reinhold, New York n.d.) Introduction to Mammoth Cave Area's Hydrology, The Occurrence of Karst Aquifers pp 3-4 par 4 on p 4.

¹¹The TNRCC (Texas Natural Resource (Conservation) Commission) has been changed to TCEQ (Texas Commission of Environmental Quality). The following link www.tnrcc.state.tx.us will automatically send one to the now renamed TCEQ site.

¹²See Quick review through photos (11-9-02) and descriptions. P.12 of this writing.

¹³ United States Geological Survey (USGS)
http://water.usgs.gov/ogw/karst/kigconference/elk_traveltimes.htm Travel Times Along Selected Paths of the Edwards Aquifer, Central Texas, Abstract p.1 par1

¹⁴ Ibid, Selected Flow Paths table 1.

Ibid, p 9 last sentence, " The least conclusive aspect of the analysis is associated with estimates of pore velocity and times of travel due to the poor understanding of effective thickness or the distribution of effective porosity within the Edwards aquifer."

¹⁵ KARST HYDROLOGY Concepts from Mammoth Cave Area Edited by William B. White and Elizabeth L. White (Van Nostrand Reinhold, New York n.d.) Introduction to Mammoth Cave Area's Hydrology, Land-Use Hazards in Karst p.2

¹⁶ KARST HYDROLOGY Concepts from Mammoth Cave Area Edited by William B. White and Elizabeth L. White (Van Nostrand Reinhold, New York n.d.) Introduction to Mammoth Cave Area's Hydrology, Land-Use Hazards in Karst p.2-3, et passim

¹⁷ KARST HYDROLOGY Concepts from Mammoth Cave Area Edited by William B. White and Elizabeth L. White (Van Nostrand Reinhold, New York n.d.) Introduction to Mammoth Cave Area's Hydrology, Groundwater Supply and Groundwater Pollution, pp3-4 par 4 et passim at websites www.tnrcc.state.tx.us, <http://www.edwardsaquifer.org>

¹⁸ "PLINKO" The Price is Right, hosted by Bob Barker, CBS Television Game-show. The contestant is given one free disk and must play a game of figuring prices on items as to win additional disk (chances). The game consists of a disk or disks being dropped down on a semi upright pegged board by contestants. The start is unmarked but the final resting spot of the disk shows certain money amount the contestant can win ranging from zero to ten thousand dollars. The disk does get stuck from time to time part of the way down and must be shaken to release.

¹⁹ Point Source <http://www.epa.gov/earth1/r6/6en/w/ptsource.htm> EPA, Compliance Assurance and Enforcement region 6, definition of point source contamination. "40 CFR 122.2 For purposes of the Clean Water Act, "Point Source" means any discernible, confined, and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill, leachate collection system, vessel or other floating craft from which pollutants are or may be discharged. This term does not include return flows from irrigated agriculture or agriculture storm water runoff."

²⁰ So far the only article correlating firefighting actions or inactions and an aquifer can be found at <http://www.usfa.fema.gov/applications/publications/tr009.cfm> contains Adobe Acrobat PDF 807 Kbytes file report of May 27, 1987 Dayton, Ohio Sherwin-Williams Fire Incident.

²¹ "PLINKO" The Price is Right, hosted by Bob Barker, CBS Television Game-show. See endnote num 18 for explanation.

²² KARST HYDROLOGY Concepts from Mammoth Cave Area Edited by William B. White and Elizabeth L. White (Van Nostrand Reinhold, New York n.d.) Introduction to Mammoth Cave Area's Hydrology, Groundwater Supply and Groundwater Pollution, p 4

²³ Frank R. Spellman, Ph.D. The Science of Water Concepts and Applications Environmental Hydrology, 5.6.2. Transport of Polluted Waters by Subterranean Karst Flow Systems p.132 par 2

²⁴ It seems that at this time due to sources of contamination are difficult to find, aquifers or aquifer recharge zones are not considered in the writing of NFIRS (National Fire Incident Reports). Protection of visible hazards such as visible bodies of water (e.g. creeks, rivers, lakes etc.) are considered in pre-fire planning. Aquifers it seems aren't. Therefore finding written

documentation correlating fire incidents with possible well closures, or possible aquifer contamination is not possible at this time.

²⁵<http://www.usfa.fema.gov/applications/publications/tr009.cfm> contains Adobe Acrobat PDF 807 Kbytes file report of May 27, 1987 Dayton, Ohio Sherwin-Williams Fire Incident.

²⁶ Ibid, After, having read the report the summary I wrote afterwards was similar to the short summary given by USFA (United States Firefighting Academy). The USFA has a summary as a prelude to downloading 807 Kbytes PDF file. Therefore highlighted section was written, et passim.

²⁷ National Fire Codes Subscription Service 2001 edition reviewed and found no information concerning groundwater or aquifer protection.

Reviewed websites if any, of the following persons or places and then called or was contacted. Website searches for this issue were initiated on or about September 2002. Some contacts are still ongoing. Most government phone calls and face to face contacts occurred during the month of October 2002.

^a Contacted Joel Karin, retired construction quality control observer. Saw firsthand damages due to accidents during construction to recharge zone areas. Provided actual piece of porous rock formation for me to see. He encouraged and motivated me to continue research.

^b Contacted Charles English regarding Insurance. Too encouraged further research.
May be contacted at englishcee@hotmail.com for further information.

^c Contacted by phone and in person. EAA, Bexar County, Board of Directors Member, Martin "Jerry" Green District 7. Q and A how the aquifer works. Contact EAA, *see note 27d for contact information.*

^d Contacted George Rice (Hydrologist) in person Q and A. He is now a member of the Edward's Aquifer Authority Board. Contact information for EAA Board Members:

Edwards Aquifer Authority

1615 N. St. Mary's St.

San Antonio, Texas 78215

Telephone: (210) 222-2204 or 1-800-292-1047 Fax: (210) 222-9869

^e Contact by Phone and e-mail: Texas Department of Insurance Commissioner, Jose Montemayor's Office. <http://www.tdi.state.tx.us/index.html> referred me to Fire Marshal

Texas Department of Insurance

333 Guadalupe

Austin, TX 78701

512 463-6169 Æ 800 578-4677

Mailing Address

Texas Department of Insurance

P.O. Box 149104

Austin, TX 78714-9104

^f Contacted by Phone by Texas State Fire Marshal's Office, Fire Marshall Mike Davis. <http://www.tdi.state.tx.us/fire/indexfm.html> conclusion no standards for recharge zones exist or could be found regarding firefighting. Referred to Ed Salazar Insurance Commissioner and Fire Marshal's Office Attorney.

^aContacted by Phone and e-mail by Ed Salazar Attorney of Texas Department Insurance Commissioner and Texas State Fire Marshal's Offices. Findings were that state legislation was the next step on such issues. <http://www.tdi.state.tx.us/index.html>

State Fire Marshal's Office

333 Guadalupe
Austin, TX 78701
512 305-7900

Mailing Address
Fire Marshal
P.O. Box 149221
Austin, TX 78714-9221

^bContacted by Phone after sending e-mail to TNRCC (TCEQ). Findings such training is not in their jurisdiction plus it is non-existent. Unfortunately actions towards contamination are reactions taken after the fact through remediation. **TNRCC / TCEQ Contact Information:** www.tnrcc.state.tx.us There is no general information 1-800 number and the general switchboard contact number is: (210) 239-1000 ask San Antonio, Texas. Questions should be directed to Environmental Control Personnel.

ⁱContacted Richard Martinez Ph.D. (UCLA), in person Urban Planning and Development, helped by mentioning OSHA and how OSHA has firefighting runoff regulations for Baytown chemical plant near bayou.

^jContacted by telephone after sending e-mail to OSHA. OSHA returned my call and stated that no such training or preventive measures exist for aquifer recharge zones. Fire Brigades for specific locations are contended with. Only already set rules exist such as those for protection of bayous and other bodies of water. OSHA had first referred me to the TNRCC then called to clarify. <http://www.osha.gov> Contact 1-800-321-OSHA (6742)... TTY 1-877-889-5627

Occupational Safety & Health Administration

200 Constitution Avenue, NW
Washington, DC 20210

Region 6 Office Encompassing, Arkansas, Louisiana, New Mexico, Oklahoma and Texas

Regional Office

525 Griffin Street, Room 602
Dallas, Texas 75202
(214) 767-4731
(214) 767-4693 FAX

^kContacted the Texas Commission of Fire Protection Certification Office by phone and was told no firefighting over aquifers information exist <http://www.tcfp.state.tx.us/index.asp> was referred to, Emergency Training Institute.

Texas Commission on Fire Protection

P.O. Box 2286
Austin, Texas 78768-2286

Phone: (512) 239-4911 FAX (512) 239-4917 E-mail: www.info@tcpf.state.tx.us

^lContact by Phone: Emergency Training Institute. Found no such training exists, nor, according to NFPA instructor, is such information to be found in the NFPA handbook. The

Institute is a member of Texas A&M University system, Texas Engineering Extension Service (TEEX) <http://www.teex.com/index.html> Telephone: (877) 833-9638

^m <http://www.osha.gov/> used for contact information

ⁿ <http://www.tcfp.state.tx.us/index.asp> Texas Commission of Fire Protection, certification

^o <http://www.tcfp.state.tx.us/links.asp> site with links to a number of sites related to fire protection

^p "Contacted George Suther, President of," The San Antonio Professional Firefighters Association." Encouraged research.

The San Antonio Professional Fire Fighters Association

8925 West IH-10

San Antonio, Texas 78230

Phone: (210) 699-9400 FAX (210) 699-9400 E-mail www.iaff624.com

^q "Contacted Curtis Franz retired Assistant Fire Chief of the City of San Antonio now presiding President of the "San Antonio Fire and Police Pensioners's Association." Encouraged research.

San Antonio Fire and Police Pensioners Association

311 Roosevelt

San Antonio, Texas 78210

^r Visited ongoing construction sites. Found building codes and materials used are the same as for any other area.

^s *Note: Many city and state staff were curious about my research but due to employment rules and regulations they were unable to respond for the record.*

^t Conclusion: There are no state, federal or local training or SOP's that specifically mention an aquifer as a sensitive exposure to protect.

²⁸ National Fire Codes Subscription Service 2001 edition, requires that all construction must provide an avenue that gives occupants time to escape in a case of fire. The materials used are at times fire retardant but even then inadvertent modifications during or after its installation can cause it to fail. Fire retardant materials can only slow the spread of fire for a given amount of time depending on heat.

²⁹ <http://www.osha.gov/> Occupational Safety and Health Administration

³⁰ www.tnrc.state.tx.us website will take one to the new TCEQ site.

³¹ "Combustion" Science and Technology Encyclopedia 8th ed. (New York: McGraw-Hill)

"Pyrolysis" Science and Technology Encyclopedia, 8th ed. (New York: McGraw-Hill)

³² "Smoke" Science and Technology Encyclopedia, 8th ed. (New York: McGraw-Hill)

"Ash" World Book Encyclopedia, 2001 edition

"Fire" World Book Encyclopedia, 2001 edition

³³ "Pyrolysis" Science and Technology Encyclopedia, 8th ed. (New York: McGraw-Hill).

³⁴ "Smoke" Merit Students Encyclopedia 1982ed. (New York: Macmillan Educational Company).

³⁵ Comments on EPA's Management Measures to Control Non-point Source Pollution from Forestry, <http://www.safnet.org/policy/psst/epa92501.htm> The Society of American Foresters (SAF) is professionally obligated to provide the following comments on the Environmental Protection Agency's draft publication entitled, National Management Measures to Control Nonpoint Source Pollution from Forestry, published in the Federal Register on June 27, 2001 (Federal Register, 66(124):34190-34191).

³⁶James H. Meidl Explosive and Toxic Hazardous Materials, (Macmillan Publishing Company, New York and Collier Macmillan Publishers, London 1970) Toxic Materials Class B Poisons Chapter 6, p 202, Table 16. Poison B Aromatic Compounds, Dinotrophenol, used in dyes and wood preservatives "highly toxic by inhalation, ingestion, or skin absorption. Emits toxic vapors when burning."

³⁷James H. Meidl Flammable Hazardous Materials, (Macmillan Publishing Company, New York and Collier Macmillan Publishers, London 1970, 1978) 2nd edition, p 263, Table 10-8. Vinyl Plastics, Typical uses of polyvinyl (acetal, alcohol, butyral, chloride, chloride-polyvinyl acetate copolymer, polyvinylidene chloride), adhesives, inks, plastic woods, dyes, soaps, detergents, safety glass, automobile seats covers, flooring upholstery, wall and corrugated fence toppings, tarpaulins, foam packaging, textile fibers, baby pants, shoes, rainwear, shower curtains, vinyl records, coatings, upholstery fabric, screening, draperies and food wrap. Due to concern for flammability vs. toxicity, toxicity is ranged from low to moderate to fairly toxic flammable.

³⁸James H. Meidl Explosive and Toxic Hazardous Materials, (Macmillan Publishing Company, New York and Collier Macmillan Publishers, London 1970) Toxic Materials Class B Poisons Chapter 6, pp 196-197 Table 14. Characteristics of Selected Compounds that Contain the Cyanide Ion, Uses of different substances for insecticides, special solvents, plastics, nylon, fumigants, gold recovery, electroplating, to case harden steel.

³⁹See endnote 27. Gathered from all the questions and answers from countless individuals.

⁴⁰U.S. Environmental Protection Agency, Polluted Runoff (Non-Point Source Pollution), <http://www.epa.gov/owow/nps/MMGI/Chapter4/ch4-6.html>, b. Improper Disposal of Used Oil Stella Pyrttek-Blond, head of Public Relations for Clean Air Performance Professionals (CAPP). MTBE Contamination May be Spreading <http://www.autoca.org/chat/0000001f.htm> (September 30, 2001 Column) "MTBE gasoline additive for smoke reduction, one once can contaminate 1000 tons of water."

MTBE BAN LEGISLATION, HOUSE 4359, A REPORT ON GASOLINE ADDITIVE METHYL TERTIARY BUTYL ETHER (MTBE) IN MASSACHUSETTS: MTBE'S, By REPRESENTATIVE DEMETRIUS J. ATSALIS 2ND BARNSTABLE DISTRICT, THE STATE HOUSE, BOSTON, MA 02133, June 2001, Threat to Citizens' Health and Drinking Water, "One gallon of gasoline contains 11% by volume of MTBE. "A gasoline tanker truck containing 15,000 gallons of gasoline contains 1,650 gallons of MTBE. That is enough to contaminate 41 billion gallons of water." dissolve easily and rapidly into groundwater, stick to water particles, making it extremely difficult and expensive to remove." It is also said that such is to be banned by 2003.

⁴¹SALT LAKE, UTAH CITY CODE 1987, Title 21A ZONING, Part III. Specific District Regulations, Chapter 21A.34 OVERLAY DISTRICTS, 21A.34.060 Groundwater Source Protection Overlay District http://www.epa.gov/nps/ordinance/documents/salt_lake_city_wpd G. Management Strategies; Best Management Practices: 1. Toxic, Hazardous, And Other Materials Handling Regulations: a. Storage Containers, b. Secondary Containment, c. Regulated Substances Emergency Management Plan, d. Reporting Of Spills, 2. Best Management Practices: a. Underground Storage Tanks, b. Septic Tank Systems

⁴²Contacted George Arce, experienced Truck Driver.

⁴³San Bernardino Fire Department http://www.sbcfire.org/ofm/hhw/proper_hcm.shtml, Proper Household Chemical Management, "medications, paint, motor oil, antifreeze, auto batteries, lawn care products, pest control products, drain cleaners, pool care products such as chlorine and acids, and household cleaners," automobile additives.

⁴⁴ Bexar County Local Emergency Planning Committee <http://bclepc.stic.net/> contains map and list of incidents, Hwy 281 allows for hazardous material route over the recharge zone because it was found that the importance of having a fueled airport superceded rerouting measures. Look for incident of underground tank leak of 900 gallons of gasoline. The incident may have helped to keep encouraging recent EAA regulations regarding prohibition of underground tanks. Sadly the politics of big corporations did not allow for Gasoline stations over recharge zone to adhere to such prohibitions as of yet.

⁴⁵ Environmental protection Agency
<http://www.epa.gov/oerrpage/superfund/tools/gw/brochure.htm> What is Superfund? What Does Superfund Do About Contaminated Ground Water? Why Can Ground Water Cleanup Take So Long? What We Have Learned About Ground Water Cleanup

⁴⁶ The Texas Natural Resource Conservation Commission (TNRCC) now the Texas Commission of Environmental Quality (TCEQ), www.tnrcc.state.tx.us website will take one to the new TCEQ site. There a search can be made of different remediation in progress or archive.

⁴⁷ The City of San Antonio, Texas, Ordinance 95579, Cibolo Creek Conservation District, regarding the development of a PGA Village, is considered a growth magnet catalyst over the Edwards sensitive recharge zone. Development has already occurred over some of the area but, as for what tested firefighting guidelines exist, for fighting fires over such areas, all that can be said is that remediation is the norm. Clean up after the fact if possible by TNRCC monies or other.

⁴⁸ Case Study: Preventing Ground Water Contamination Environmental Services Division State of Michigan, Departments of Commerce and Natural Resources, Education/Outreach Recycling/Energy Site Reuse & Redevelopment Small Business Clean Air Assistance February 1993 #9301, <http://es.epa.gov/techinfo/case/michigan/michcs15.html> Preventing Groundwater Contamination " Businesses responsible for groundwater contamination can encounter fines, lawsuits and cleanup costs running into millions of dollars. Moreover, banks increasingly require environmental audits before extending loans to businesses. "

⁴⁹ Donald C. Hickman, Major, USAF, BSC, A CHEMICAL AND BIOLOGICAL WARFARE THREAT: USAF WATER SYSTEMS AT RISK September 1999, II. Taking Water for Granted. Report speaks of numerous vulnerabilities associated with the protection of water supplies in reference to domestic or terrorist threats.

⁵⁰ Justice Institute of British Columbia Fire Academy (1988) Risk Management for the Fire Service, pp 2-4 explains the criteria for negligence, p 13 par 2 as for illustration of negligent actions or failure to act, Environmental damage was caused by firefighters flushing gasoline onto a salmon-spawning creek. It may be determined that flushing of contaminant as such did not meet the standard of care reasonably expected from such personnel.

⁵¹ <http://www.ftrr.gov/> about FRTR, "The Federal Remediation Technologies Roundtable (FRTR) works to build a collaborative atmosphere among federal agencies involved in hazardous waste site cleanup." <http://www.ftrr.gov/resources.htm> good source for additional links.

⁵² John, R., Cashman, Hazardous Materials Emergencies (Technomic Publishing Company, Inc., Lancaster Pennsylvania, 1988) Chapter 11 Hazardous Materials Emergencies- Case Histories pp. 297-337 list a number of different incidents that have occurred. Notice that aquifers are not mentioned but creeks, rivers and other waterways are. Incident reports of today are similar in nature that visible waterways are reported in incident reports.

⁵³ Fire Protection Guide to Hazardous Materials 10th ed. (National, NFPA 1991) sec. 704 pp. 1-14, Standard System of Identification, Identification of the Fire Hazards of Materials. Seems to only pertain to large quantities of specific substances. Therefore it may be necessary to create a new insignia or symbol to warn of potential exposure.

NFPA National Fire Codes Subscription Service 2001 ed. (NFPA 2001) Sec. 704 pp.1-22 authoritative explanation concerning NFPA 704 Identification System.

FEMA. (1985). Recognizing and Identifying Hazardous Materials (FEMA, February 15, 1985) NFA-SM-RIHM/TtT, FEMA Unit III, p. III-2 Detecting Hazardous Materials Presence, p. III-5, Placard and Label Notes, pp III-6, 7, NFPA 704 System Explained.

⁵⁴ G. Weis, Hazardous Chemicals Data Book 2nd ed. (Noyes Data Corporation Park Ridge, New Jersey, U.S.A., 1986) pp 16-17 has a compatibility chart as to how different chemicals when mixed can react pp. 39-1054 list 1015 chemical charts explaining when available but not limited to fire (flammability) exposure, water pollution (affects on aquatic life) health hazard etc.

Richard P. Pohonish & Stanley A. Greene, Editors Hazardous Substances Resource Guide (Gale Research Inc. Detroit, Michigan 1993) pp1-312 contains 1047 "Chemical Profiles," including but not limited to giving a "danger profile," from carcinogens to EPA Right- to- Know of chemicals that produce toxic fumes in fire. Many are everyday household products.

⁵⁵ International City Management Association. (1988). Managing Fire Services (2nd ed.) ICMA Training Institute p.27 par.1 President Nixon empowered a committee in 1972 creating America Burning Report. par 3-5 President Gerald Ford signed public law 90-438 creating NFPCA later became USFA. Ultimately created the use of NFIRS for analysis, education and the pinpointing of fire problems.

⁵⁶ Thumbrules not including friction loss.

ATTACK PUMPER

HANDLINES			LEADERS			
TIP	FLOW	PRESSURE	GPM	Pressure	FRICTION	LOSS
RED LINE	15-30	200	200	150-F.L.		
PRECONNECT	200	170	400	150-F.L.		
LEADERS	200/400	150 AT WYE				

LADDER PIPE			MONITORS		
TIP	FLOW	Pressure	TIP	FLOW	Pressure
FOG	1000	145	FOG	1250	
FOG	500	145	2 Inch	1000	
1 1/2	600	135	FOG	500	
1 3/4	500	125	1 3/4	800	
1 1/4	400	120	1 1/2	600	
			1 3/8	500	

⁵⁷ Discussions with Margaret Greco (Archeologist) brought to light that there were springs as well as a once treasured "hidden" *paleolithic* archeological site that too became victim to development. According to Encyclopedia Americana (1958) Vol.2 page 152 Archeology, Old World, Paleolithic:" Paleolithic archeology deals with the development of human culture during the immense span of time between the first appearance of man as a tool-using mammal and the beginning of recent geologic time, about 8000 B.C."

⁵⁸ GROUND-WATER CONTAMINATION AND REMEDIATION IN NEW MEXICO: 1927-2000 Dennis McQuillan and Jennifer Parker, New Mexico Environment Department

Ground Water Quality Bureau July 2000, Abstract par 4, "depth to water," Found that the distance between the surface and the water below ground has nothing to do with preventing contamination (Distances of 200-600 feet were used).

Bibliography

What is an Aquifer <http://pasture.ecn.purdue.edu/~epados/ground/ascii/tomstext.txt> What is an Aquifer, sponge comparison is made.

Bexar County Local Emergency Planning Committee <http://bclepc.stic.net/>

Brannigan, F.L., (1982) Building Construction for the Fire Service (2nd ed.) National Fire Protection Association.

Brunacini, A.V. (1985) Fire Command National Fire protection Association.

Case Study: Preventing Ground Water Contamination Environmental Services Division State of Michigan, Departments of Commerce and Natural Resources, Education/Outreach Recycling/Energy Site Reuse & Redevelopment Small Business Clean Air Assistance February 1993 #9301, <http://es.epa.gov/techinfo/case/michigan/michcs15.html> Preventing Groundwater Contamination "

Cashman, J. R. (1988) Hazardous Materials Emergencies Technomic Publishing Company, Inc., Lancaster Pennsylvania.

Clean Water Act <http://www.epa.gov/earth1r6/6en/w/cwa.htm> EPA, Compliance Assurance and Enforcement region 6, article

DESIGNATED SOLE SOURCE AQUIFERS IN EPA REGION VI.
<http://www.epa.gov/safewater/swp/ssa/reg6.html> EPA, Map and listing of sole source aquifers.

Edwards Aquifer Authority http://www.edwardsaquifer.org/Pages/frames_aquifer.html

The Encyclopedia Americana (1958 ed.)

EPA http://www.epa.gov/ogwdw000/protect/98_305b_all.pdf pp. 38-40 Ground Water: The Invisible Resource

EPA http://www.epa.gov/ogwdw000/protect/98_305b_gwqchap.pdf pp. 4-9 Ground Water Quality, Fuel storage.

EPA <http://www.epa.gov/safewater/protect/individ.html> EPA Source Water Protection, Quick Things You Can Do! Num. 1,2 and 3. Household awareness of everyday use household contaminants.

EPA. <http://www.epa.gov/oerrpage/superfund/tools/gw/brochure.htm> What is Superfund? What Does Superfund Do About Contaminated Ground Water? Why Can Ground Water Cleanup Take So Long? What We Have Learned About Ground Water Cleanup.

Esquilin, R., Compiled by, (2001) EDWARDS AQUIFER BIBLIOGRAPHY THROUGH 2001 http://www.edwardsaquifer.org/Pages/frames_aquifer.html

Fact Sheet: The Effect Of Superfund On Involuntary Acquisitions Of Contaminated Property By Government Entities.
<http://www.epa.gov/Compliance/resources/policies/cleanup/superfund/fs-involacqurpty-rpt.pdf>

Federal Register, 66(124): 34190-4191 <http://www.safnet.org/policy/psst/epa92501.htm>
National Management Measures to Control Nonpoint Source Pollution from Forestry,
published in the Federal Register on June 27, 2001 (Federal Register, 66(124):34190-34191).

FEMA. (1984). Fundamentals Course for Radiological Monitors SM 81, FEMA
September 1984.

FEMA. (1985). Hazardous Materials Incident Analysis NFA-SM-HMIA/TtT, FEMA February 1, 1985.

FEMA. (1985). Recognizing and Identifying Hazardous Materials NFA-SM-RIHM/TtT, FEMA February 15, 1985.

FRTR <http://www.frtr.gov/> "The Federal Remediation Technologies."

FRTR <http://www.frtr.gov/resources.htm> good source for additional links.

HEARING ON REFORMULATED GASOLINE (RFG)-PART I TUESDAY, SEPTEMBER 14, 1999, House of Representatives, Subcommittee on Energy and Environment, Committee on Science, Washington, DC. The Subcommittee met, pursuant to call, at 10:10 a.m., in Room 2318, Rayburn Building, Hon. Ken Calvert (Chairman of the Subcommittee) presiding. House of Representatives Hearing, transcript regarding MTBE

Hickman, D., C., Major, (1999) USAF, BSC, A CHEMICAL AND BIOLOGICAL WARFARE THREAT: USAF WATER SYSTEMS AT RISK September 1999, II.

International Fire Service Training Association. (1982). Fire Cause and Determination (1st ed.) Fire Protection Publications Oklahoma State University.

International Fire Service Training Association. (1989). Fire Department Pumping Apparatus (7th ed.) Fire Protection Publications, Oklahoma State University.

International City Management Association. (1988). Managing Fire Services (2nd ed.) ICMA Training Institute.

Justice Institute of British Columbia Fire Academy (1988) Risk Management for the Fire Service.

McQuillan, D. & Parker, J. GROUND-WATER CONTAMINATION AND REMEDIATION IN NEW MEXICO: 1927-2000 New Mexico Environment Department Ground Water Quality Bureau, July 2000, Abstract.

Meidl, J.H. (1970) Explosive and Toxic Hazardous Materials Macmillan Publishing Company, New York and Collier Macmillan Publishers, London.

Meidl, J.H. (1970,1978) Flammable Hazardous Materials (2nd ed.) Macmillan Publishing Company, New York and Collier Macmillan Publishers, London.

Merit Students Encyclopedia (1982) New York: Macmillan Educational Company.

MTBE BAN LEGISLATION, HOUSE 4359, A REPORT ON GASOLINE ADDITIVE METHYL TERTIARY BUTYL ETHER (MTBE) IN MASSACHUSETTS: MTBE'S, By REPRESENTATIVE DEMETRIUS J. ATSALIS 2ND BARNSTABLE DISTRICT, THE STATE HOUSE, BOSTON, MA 02133, June 2001, Threat to Citizens' Health and Drinking Water.

National Fire Codes Subscription Service (2001 ed.).

National (1991) Fire Protection Guide on Hazardous Materials 10th ed. NFPA

Occupational Safety and Health Administration <http://www.osha.gov/> contact information

The Olive Branch <http://www.theolivebranch.com/water/news.htm> Countless excerpts from articles by state of contamination scenarios.

Ouachita, Nevada Wood Treater <http://www.epa.gov/Arkansas/6sf/6sf-ar.htm> EPA, Superfund Region-6: Southcentral, Arkansas, PDF file.

"PLINKO" The Price is Right, hosted by Bob Barker, CBS Television Game-show.

Pohonish, R. P. & Greene S.A., Editors (1993) Hazardous Substances Resource Guide Gale Research Inc. Detroit, Michigan

Point Source <http://www.epa.gov/earth1/r6/6en/w/ptsources.htm> EPA, Compliance Assurance and Enforcement region 6, definition of point source contamination. "40 CFR 122.2.

Pump and Treat of Contaminated Groundwater <http://bigisland.ttclients.com/frtr/00000115.html>
Pump and Treat of Contaminated Groundwater at the Mid-South Wood Products Superfund Site, Mena, Arkansas

Pyrtek-Blond, S. http://www.autoca.org/_chat/0000001f.htm September 30, 2001 Column.

REAGAN, R., WHITE HOUSE, March 15, 1988, Government Actions and Interference with Constitutionally Protected Property Rights EXECUTIVE ORDER NO. 12630 March 15, 1988, 3 C.F.R. 554
<http://www.epa.gov/OWOW/wetlands/regs/eo12630.html>

Residential Fire Loss Estimates 1988 <http://www.cpsc.gov/LIBRARY/fire98.pdf>

Richman, H. (1986). Engine Company Fireground Operations (2nd ed.) National Fire Protection Association.

Richman, H. (1986). Truck Company Fireground Operations (2nd ed.) National Fire Protection Association.

SALT LAKE, UTAH CITY CODE 1987, Title 21A ZONING, Part III. Specific District Regulations, Chapter 21A.34 OVERLAY DISTRICTS, 21A.34.060 Groundwater Source Protection Overlay District http://www.epa.gov/nps/ordinance/documents/salt_lake_city.wpd
G. Management Strategies; Best Management Practices: 1. Toxic, Hazardous, And Other Materials Handling Regulations: a. Storage Containers, b. Secondary Containment, c. Regulated Substances Emergency Management Plan, d. Reporting Of Spills, 2. Best Management Practices: a. Underground Storage Tanks, b. Septic Tank Systems

San Bernardino Fire Department http://www.sbcfire.org/ofin/hhw/proper_hcm.shtml Proper Household Chemical Management, "medications, paint, motor oil, antifreeze, auto batteries, lawn care products, pest control products, drain cleaners, pool care products such as chlorine and acids, and household cleaners," automobile additives.

Science and Technology Encyclopedia (8th ed.). New York: McGraw-Hill.

Texas Commission of Fire Protection <http://www.tcfp.state.tx.us/index.asp> Texas Firefighter Certification. Plus, useful fire protection sites.

Texas Department of Insurance Commissioner, Jose Montemayor Office.
<http://www.tdi.state.tx.us/index.html>

Texas State Fire Marshal's Office, Fire Marshall Mike Davis.
<http://www.tdi.state.tx.us/fire/indexfm.html>

Tips for Consumers Insulating Their Homes
<http://www.cpsc.gov/CPSCPUB/PREREL/prhtml77/77102.html>
NEWS from CPSCU.S. Consumer Product Safety Commission Office of Information and Public Affairs Washington, D.C. 20207 September 30, 1977 Release # 77-102

U.S. Environmental Protection Agency, Polluted Runoff (Non-Point Source Pollution)
<http://www.epa.gov/owow/nps/MMGI/Chapter4/ch4-6.html>, b. Improper Disposal of Used Oil

United States Fire Academy, FEMA <http://www.usfa.fema.gov/dhtml/fire-service/table1.html>
(Notice how even the minimal situations require protection).

United States Fire Academy, FEMA <http://www.usfa.fema.gov/dhtml/fire-service/strategy.html>
(Notice how even the minimal situations require decontamination).

United States Fire Academy, FEMA,
<http://www.usfa.fema.gov/applications/publications/tr009.cfm>
Contains Adobe Acrobat PDF 807 Kbytes file report of May 27, 1987 Dayton, Ohio
Sherwin-Williams Fire Incident.

University of Maine Cooperative Extension, DRINKING WATER CONTAMINATION:
UNDERSTANDING THE RISKS,
<http://hermes.ecn.purdue.edu/cgi/convwqtest?fs-5.me.ascii>
Balancing Risks And Benefits par 3, household products.

Weis, G., (1986) Hazardous Chemicals Data Book (2nd ed.), Noyes Data Corporation Park Ridge,
New Jersey, U.S.A.

World Book Encyclopedia (2001 ed.).